ECOSYSTEM STATUS INDICATORS
Physical Environment

GULF OF ALASKA
Winter Mixed Layer Depths at GAK 1 in the Northern Gulf of Alaska

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Last updated: September 2005

The coastal northern Gulf of Alaska is forced predominately by downwelling inducing winds. In spite of this, the shelf is a region of high biological productivity. Various mechanisms have been suggested for the transport of nutrients across the shelf. One method of moving nutrients from the deep ocean to the shelf could be cross shelf transport of nutrient rich waters along the shelf bottom, especially within submarine canyons during periods of relaxed downwelling. In this scenario, mixed layers at certain times of the year could reach deep enough to mix nutrient-rich waters into the euphotic zone. In the northern Gulf of Alaska, mixed layers are deepest in the winter, when air and water temperatures are low, salinity is high as freshwater is locked up as snow and ice, and evaporation and wind stress are high.

Hydrographic station GAK 1 is located at 60 N, 149 W, at the mouth of Resurrection Bay in the Northern Gulf of Alaska. Temperature and salinity measurements have been made at various times of the year at this location since 1973. We have estimated the deepest winter mixed layer depths (MLDs) using the Freeland et al. (1997) algorithm. This algorithm performs well at estimating winter MLDs (each winter is defined here as December of one year and January to May of the following year), but overestimates the summer and spring MLDs. For our purposes, this method is adequate as it also conserves the integrated mass, and thus the potential energy of the water column.

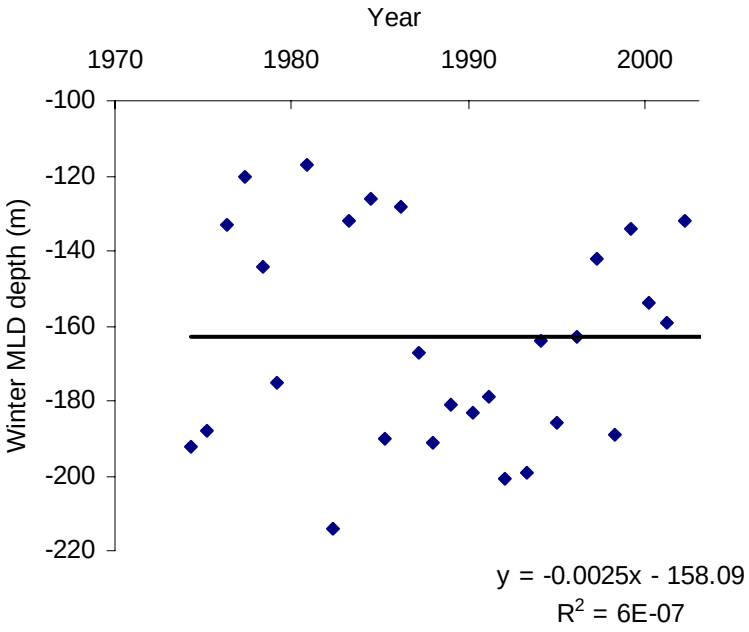

Figure 17. Winter mixed layer depth (m) at GAK 1 from 1974-2005.

The deepest winter MLDs at GAK 1 from 1974 to 2005 (Figure 17) range from a minimum of 105 m in February 2003 to a maximum of 214 m in March 1987. The mean value is 163 m, with a standard deviation of 29 m. The record has only one missing value; that for the winter of 1979-1980. The deepest MLD of the 2002-2003 winter is the shallowest of the 31 year record, however the winters of 2003-2004 and 2004-2005 had deeper than average mixed layers.

The deepest winter MLDs from 1974 to 2005 show a deepening linear trend. Nevertheless, this trend is not statistically significant. Thus the only conclusion is that during 1974-2005, there have been no significant changes in the deepest winter MLDs at GAK 1. This is in contrast to studies

by Freeland et al. (1997) who report a significant shoaling trend at Ocean Station P at the center of the Alaska gyre from 1956 to 1994. If this dissimilarity of trends at the center and edge of the gyre did exist, it would indicate that the gyre is spinning up. However, all that can be said is that the deepest winter MLD at the coast in the northern Gulf of Alaska is not changing.